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ABSTRACT

Creative and successful ways to develop reasoning-centered classrooms are described. An informative testing method, which was developed by Larry Michaelson (University of Oklahoma Division of Management) begins with students taking a quiz and turning in their results. Then they retake the quiz in a permanent group of five or six students who must arrive at a consensus on each item. Group scores have been higher than individual scores, and students report improved problem-solving skills. Another model, Guided Design, developed by Charles Wales (West Virginia University), allows students to work in teams on complex problems, guided by a decision-making model presented in steps by the instructor. Problem-centered small group instruction known as the "ADAPT" program was developed by Robert Fuller (University of Nebraska-Lincoln). Both ADAPT and a spinoff called SOAR use a Piaget-based model called the learning cycle to guide students from concrete, hands-on learning experiences to abstract formulations of principles and their applications. Additional approaches include: programs using collaborative learning; a simulation involving controversy to help improve writing skills; projects that incorporate controversy, writing, and collaborative learning; and using informal writing to enhance learning. (SW)

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THE REASONING-CENTERED CLASSROOM

APPROACHES THAT WORK

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by Joanne Kurfiss

The essential ingredients of successful teaching for thinking are the basic elements of academic inquiry and discourse: problem solving, controversy, informal and formal writing, and student-to-student dialogue and collaboration. These ingredients are not new; successful teachers have used them for years to involve students in learning. What differs is their use in new combinations, and their inclusion as part of the in-class agenda in what I will refer to as the "reasoning-centered classroom."

The goals of reasoning-centered instruction vary to reflect the intellectual demands of the discipline and course content. For example, an instructor may want students to interpret literary works, analyze case study materials, think critically about social issues, or investigate problems using scientific methods. The instructor designs learning activities that allow students to practice using a desired skill. This generates feedback from both peers and instructors, thereby sharpening students' skills and improving self-confidence before formal evaluations.

This article describes several creative, and successful, approaches to the development of reasoning-centered classrooms.

INFORMATIVE TESTING

A common problem faced by faculty interested in developing students' reasoning abilities is how to avoid the "lecture trap." Many faculty feel compelled to lecture on course material that is covered in readings simply because many students seem unwilling or unable to master the material on their own. This robs the class of time to discuss applications or implications of the material.

Informative testing, developed by Larry Michaelson of the University of Oklahoma Division of Management, charges students with the responsibility of mastering reading material so that class time can be used for more advanced applications. Informative testing begins where most instruction ends: with a quiz. Students take the quiz individually, then turn in their results and retake the quiz, this time in a permanent group of five or six students who must arrive at a consensus on each item. Both the individual and group scores count toward grades; groups may appeal wrong answers in writing. Lectures focus on material missed by a significant segment of the class. Since basic material is covered early in the unit, the instructor is free to devote class time to case studies and other applications.

Michaelson reports that group scores are higher than individual scores in 95% of cases, and final examination scores (taken individually) are comparable to those of classes in which traditional methods are used. Students report improved problem-solving skills and heightened interest in learning when this method of instruction is used. And, it works well even in classes (such as Michaelson's) with several hundred students.

Decision-making skills improve when instructors use a model called Guided Design, developed by Charles Wales of West Virginia University. Students work in teams on complex problems, guided by a decision-making model presented in steps by the instructor. When each team completes a step, the instructor provides

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feedback in the form of a progress report from a hypothetical team working on the same problem. The hypothetical team is not necessarily doing the best possible job; its work simply provides a point of comparison for the class. Once a decision is made one team member prepares a group report, while the other students prepare individual reports for final evaluation by the instructor.

Guided Design, which is used in the freshman engineering sequence at WVU, has had a significant impact on retention, grade point average, and employer desirability of graduates from WVU's chemical engineering program. In a classroom study by D. E. Hursh, students instructed by the Guided Design feedback model improved their decision-making skills; however, simply introducing the problem-solving model had little impact on students' decision-making ability, even with instructor guidance available. Guided Design has been applied in disciplines as diverse as anthropology and theatre, and in courses from the freshman to graduate level.

Freshmen develop formal reasoning abilities through problem-centered small group instruction in the well-known ADAPT program, developed by Robert Fuller at the University of Nebraska-Lincoln (UNL), and in spinoffs such as the SOAR program at Xavier University in New Orleans. These programs use a Piaget-based model called the "learning cycle" to guide students from concrete, hands-on learning experiences to abstract formulations of principles and their applications. At UNL, Carol Tomlinson Keasey found significant gains in formal reasoning abilities and above average satisfaction with faculty among ADAPT students, over half of whom were from the lower third of their high school graduating classes. J. W. Carmichael, professor of chemistry at Xavier, reports significant test score gains, above average rates of completion of science majors, and higher medical and dental school acceptance rates for students who participate in the six-week prefreshman SOAR program.

Collaborative learning also benefits students at advanced levels of professional education. Using intensive

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small group discussions, Robert Blanc and Michael Moninger of the University of Missouri-Kansas City School of Medicine were able to accomplish in twelve weeks what two years of medical education could not do for 34 (out of a group of 38) medical students: prepare them to pass Part I of their National Boards. In *The Anatomy of Judgment*, M. L. J. Abercrombie reports that medical students who worked together to diagnose cases developed diagnostic skills more rapidly than students who simply presented individual diagnoses to each other. And, according to Neal Whitman, University of Utah, medical students working on case studies in small groups develop better inquiry skills and learn to consider complex issues relevant to medical diagnosis and treatment.

In a course at the C.E.G.E.P. de Drummondville (Quebec), a simulation game allows history professor Pierre Corbeil to replace traditional lectures with problem solving, collaboration, and writing. The gameboard is a huge polar projection map of the world; teams of students represent participating countries. Play is based on "Diplomacy," a commercial game that has been modified by the professor. Teams respond to a series of scenarios representing the global situation at various points in recent history. Each team formulates a written plan executed by the instructor; teams then analyze the results in writing. The game fosters student involvement (including negotiations, "intelligence" operations, and information seeking) beyond the classroom. With Piagetian psychologist Dany Laveault, the instructor has found that the game is as effective as traditional instruction in conveying basic content, and more effective in helping students learn to interpret historical documents.

USING CONTROVERSY

Problem-oriented small group work is clearly a valuable resource for faculty interested in developing students' reasoning abilities. Controversy, too, can energize and benefit students' intellectual skill development.

A simulation involving controversy proved effective in helping students in remedial English classes improve their writing skills. Lynn Quitman Troyka designed a series of role plays that students enacted before writing essays on controversial topics. Students worked in teams so that no one student had full responsibility to defend a particular position. Compared to traditional instruction in freshman composition, use of role plays yielded better essays and led to greater gains on a pre-post measure of writing ability. Several hundred students in over 50 classes participated in this dramatic demonstration of the benefits of collaboration and controversy.

Controversy, writing, and small group work also converge in a model developed for use with sixth graders called "cooperative controversy." Students form teams of four, then subdivide into pairs. Each pair studies materials on one side of the issue and presents a synthesis to the other pair. Next, the pairs switch sides and repeat the process; team members then collaborate on a report expressing a consensus view on the topic. Finally, individual children write their own reports, in which they may argue for any position they choose.

The researchers found that the children's final reports incorporated more information from both sides of the issue than those written by children who participated in debates or worked alone. Cooperative controversy also generated more "epistemic cognition," or search for additional information, beyond what was given in the course (Johnson and Johnson, 1985).

At the college level, an introductory Foundations of Education course shows comparable benefits. Designed by Lynn Mortensen, University of Nebraska-Lincoln, the course uses sequenced assignments consistent with William Perry's theory of intellectual development. Students in the

course progress measurably toward reasoning based on evidence rather than authority or "mere opinion." Larry Copes at Augsburg College maintains a database that includes numerous reports of classroom research projects based on the Perry scheme; successful projects consistently incorporate controversy, writing, and collaborative learning, while balancing challenges and supports appropriate to students' developmental levels.

APPROACHES TO WRITING

The use of informal writing is another way to enhance learning and exercise intellectual skills. Two projects at Montana State University demonstrate these benefits. Shannon Taylor found that students who wrote explanations of statistics concepts did better on examination questions about those concepts than students who worked actual problems. Larry Kirkpatrick, who teaches large introductory physics classes, found that having students write weekly problem-solving "microthemes" (essays short enough to fit on an index card and organized according to a very specific format) improved final exam performance. Students also reported that the writing helped them to understand the concepts more fully; they did not consider the writing requirement burdensome.

In studies conducted at Stanford, Judith Langer and George Newell found that writing short essays invokes more complex reasoning skills than does note taking or responding to study questions. Knowledge gained from essay writing is more extensive and organized; reasoning processes such as planning, idea generation, and formulating hypotheses occur more frequently when students respond to complex questions. In addition, students responding to essay questions spend more time on the learning task, which in itself increases learning.

At another level, Chickering's research on 13 small colleges confirmed that when tests require written responses to thoughtful questions, students use higher-level reasoning processes than when they study for "objective" tests. (Memorizing is the natural response to multiple choice test formats.) A study reported in *Human Learning* revealed that students who study for essay exams do as well as or better than students who study for multiple choice exams when all are tested in a multiple choice format.

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A variation on the traditional writing assignment is the learning log or journal. Rick VanDeWeghe at the University of Colorado at Denver and Rick Leahy at Boise State University report considerable success using journals in literature courses. VanDeWeghe was able to document a shift in students' journals from responding to problems he posed to them about the reading, to posing problems for themselves. Students recorded their hypotheses, frustrations, and insights in the journals, thereby creating a detailed record of their response to course material. Without the journal requirement, much of that response would not have taken place at all.

All this suggests that students should write more, but increased emphasis on writing need not mean stacks of term papers to grade. Indeed, only two of the models described so far (Guided Design and cooperative controversy) involve what might be called term papers. The writing-across-the-curriculum movement has stimulated considerable ingenuity in assigning writing that either does not need to be graded or is relatively easy to grade. The microtheme assignments used in Kirkpatrick's physics class can be graded very quickly since they follow a prescribed format. Essay questions will always be a challenge to grade, but with adequate preparation for the task, resulting from the instructor's clarity about the desired intellectual outcomes of the course, students will write better essays in the first place. (For suggestions, consult Barry, 1984; Griffin, 1982; Fulwiler & Young, 1982).

The methods described here combine familiar elements in sometimes unfamiliar ways. They challenge traditional ideas about teacher and student roles and about the relationship between "content" and "process." They do not compete with content learning; instead, they enhance it because they recognize that students learn when they are actively investigating serious questions in a supportive learning environment. In the models I have described, faculty provide support and guidance to students while challenging them to use intellectual skills in new domains of knowledge.

All of the models described here depend for their success on the instructor's determination to share with students the intellectual excitement of his or her discipline. This sense of purpose motivates the reasoning-centered instructor to design interesting assignments, to develop effective group activities, to read and talk about teaching and learning, and to open him/herself to the possibility of learning with and from students. Students' intellectual growth depends on having multiple opportunities to learn from faculty committed to reasoning-centered instruction in both general education and major courses. For faculty, the reward is the opportunity to see students fully involved in learning—and enjoying it. ■

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